NAVAL POSTGRADUATE SCHOOL

MONTEREY, CALIFORNIA

Re-Mastering Knoppix for the MYSEA Testbed

by

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14. ABSTRACT

When a computing environment is operating in a multilevel mode, where users have different clearances, and data exists at multiple levels of classification, supporting commercial-grade operating systems and applications is a major challenge. The Monterey Security Architecture (MYSEA) at the Naval Postgraduate School is a proposed solution. A testbed has been developed to research and prototype the architecture. One part of the architecture requires "thin clients" -- workstations with no ability to save data or state locally. One approach to provide a reasonable thin client in the short term is to boot an operating system from optical media, such as a CD or DVD. Knoppix is an open source effort that provides a pre-packaged bootable Linux operating system on CD. However, the current version of Knoppix does not provide the configuration and applications required for the MYSEA testbed. This document provides a generic process for re-mastering (or re-packaging) the Knoppix CD, as well as the specific steps for producing a Knoppix CD that is usable in the MYSEA architecture.

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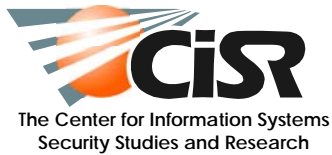
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1. Introduction

The Monterey Security Enhanced Architecture (MYSEA) Project is a research effort that is aimed at providing "a trusted distributed operating environment for enforcing multi-domain security policies, which supports unmodified COTS productivity applications." [Irvine03] Clients are able to access data at varying levels of classification on a server that enforces a multi-domain security policy. However, when commodity operating systems are employed on the clients, there is no assurance that the data is not leaked to lower classifications. To counter this problem, MYSEA, among other controls, requires the use of diskless clients.

The near-term method of providing diskless clients is to use Windows XP Professional Embedded on some clients and a Linux-based diskless implementation known as Knoppix. This paper describes how a standard Knoppix distribution was modified to support the needs of MYSEA. The steps provided in the sections that follow assume some familiarity with Unix.

2. Procedures for Re-Mastering Knoppix

This section describes how to create a new configuration of a Knoppix CD from an existing Knoppix CD. This is necessary for the MYSEA project because some specific configurations, especially network settings, need to be changed from those that come standard on a Knoppix CD. Due to factors that are probably based on the drive geometry or sector layout of the disk that was used to create the official Knoppix distribution ISO image, it may not be possible to simply re-master an image without deleting some small packages first.

2.1 Requirements

The PC specifications for the re-mastering are given below:
- 5 GB spare hard disk partition
- 1 GB RAM[1]
- Floppy drive or available USB port (for importing files)
- A system with two CD/DVD drives where at least one is a CD burner.
  It is possible to have just one CD/DVD drive that can burn CDs, but it requires the use of an additional hard disk partition, and the use of the "tohd" and "fromhd" cheat codes, or the "bootfrom" cheat code [Hacks05]. Cheat codes are additional information that can be given at the Knoppix boot prompt. The Knoppix web site has a list of cheat codes that can be used, as does the Knoppix CD at "KNOPPIX/knoppix-cheatcodes.txt".

In addition, the following software is required
- Knoppix 3.6 bootable CD
- Knoppxi 3.9 bootable CD

---

[1] If the system has less than 1 GB of RAM, then an additional 750 MB Linux swap partition is required.

ISO images for a bootable CD can be found on the Knoppix web site [Knoppix], which can then be burned onto a CD-R using standard CD writing software.

2.2 Boot Knoppix

The re-mastering starts by booting the Knoppix 3.9 CD.

When booting Knoppix on some systems the X-window server may have trouble getting started. To overcome this problem, cheat codes will have to be used.   For example, the following can be used to specify a particular resolution and X-Server:

> knoppix screen=1400x1050 xserver=XF86_SERVER

Other information, such as monitor refresh rates, can also be provided by using cheat codes.

Once booted, start a command-line window and "su" to root (which requires no password).

2.3 Generate a Kick List

The "kick list" is a list of packages that need to be deleted from a Knoppix distribution, which will be necessary if other packages need to be added, and may be needed anyway, even if no packages are added.

To help determine the packages that can be deleted, start a root window (K > Knoppix > Root Shell) and execute the following command to list all the installed packages, from the largest to the smallest:

> dpkg-query –W --showformat='${Installed-Size} ${package}\n' | sort -nr

In the output of the above command, the number to the left of each package is the amount of space the package is using on the disk. Selecting a package that other packages depend on will automatically include those dependent packages.

Create a file in the home directory named "kick.txt" containing the names of the packages to be deleted, one per line. This list will be used by a script to automate the removal process.

For the MYSEA re-mastered Knoppix CD, Appendix B lists the packages that are put into the kick list.

2.4 Generate MYSEA Configuration Files

If the target Knoppix CD shall be used to boot a thin client in the MYSEA environment, create the other configuration files in the home directory, as specified in Appendix B.

2.5 Create a new CD Image

This section describes how to install Knoppix onto a spare partition on a hard drive, in preparation for re-mastering a Knoppix CD. Perform the following steps:

1. Make sure there is a spare partition.

    See the requirements listed earlier in the document. Partitions can be created and deleted by using the fdisk command from a Knoppix Root Shell. If there is only one IDE disk, the following will start an fdisk session:

    > fdisk /dev/hda

    The fdisk command should be used with care, since existing partitions can easily be corrupted or lost through incorrect use of this command.

2. Import the knx shell script to the home directory.

    The knx shell script was written in support of the MYSEA project to simplify and quicken a process that may need to be repeated many times before the end result is satisfactory. The script is provided as Appendix A, along with an explanation of the command syntax and semantics. Be warned that a copy and paste of the script from this document to a Knoppix environment may lead to parts of the script being syntactically incorrect. Use of the "dos2unix" command may be required, as well as some manual editing to correct pasting errors.

3. Declare the partition where the Knoppix source shall be installed.

    Use the export command to define the "partition" shell variable with the specific partition defined earlier. **For example**, if /dev/hda1 is the intended target, the following command would be used:

    > export partition=hda1

    Be careful to define the correct partition because it will be reformatted, causing a loss of existing data on that partition.

4. Perform the re-mastering process by using the knx script.

    The knx script has six options that are intended to be run in the following order:
    > doformat
    > dosource
    > domaster
    > domysea (optional)
    > dokick
    > doiso

However, at the end of each option, the script will prompt whether the next option in the sequence should be performed, allowing the script to continue. Therefore, the following command will start the script with the first option, which is to prepare the target hard drive by partitioning the chosen partition:

    knx doformat

As noted above, the "domysea" option is only necessary if the CD shall be used in the MYSEA environment. If this option is not needed, then the script must be exited at that point and restarted with the "dokick" option.

Pay attention to the output of the "dokick" option, because just before it actually deletes all the packages in the kick list, it displays all the packages that it will delete (including the packages that are dependent on the packages in the kick list). Make sure there are not any unintended package deletions before continuing. In addition, the "dokick" option will display the amount of space that will be freed up if it is performed; make sure this is enough before continuing.

If non-package files or software need to be installed, then they should be added after the "dokick" step and before the "doiso" step. Be aware that the /home/knoppix subdirectory is on a RAM disk, so copying files into that area on the target partition will not have the desired result. If a new subdirectory off of the home directory is desired, then it needs to be copied to /etc/skel on the target partition, and the /etc/X11/Xsession.d/45xsession file needs to be modified on the target partition to do the copying to the RAM disk during bootup. This can be done at an appropriate spot after the "Copy profiles if not already present" comment in the 45xsession file.

At the end of the "doiso" step, the size of the ISO file is displayed. Make sure it is less than size of the CD-R to be used. For 650MB CD-Rs, the maximum capacity is about 735 MB, and for 700MB CD-Rs, the maximum capacity is about 795 MB[2]. If the image is too big, additional packages need to be added to the kick list, and the last two steps (dokick and doiso) need to be repeated.

5. Burn the ISO image to a CD.

It was found that even if the system has an available CD burner (other than the one the source Knoppix CD was booted on), the knoppix 3.9 configuration may not have enough free memory to allow the burning to take place. For systems with two CD drives, it is possible to boot Knoppix 3.6 to complete the burning process. If, however, the only CD burner was used to boot the source Knoppix CD, then the system must be rebooted from the target hard drive partition to free the CD drive.

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[2] The 650 and 700 MB designations refer to the capacity of a pressed audio CD. Due to the nature of how data is recorded on CD-Rs, they can hold more than the advertised capacity.

If the target partition needs to be booted, then reboot the source Knoppix CD. Then, at the knoppix boot prompt, enter the following cheat code to boot from the target hard drive partition (assuming /dev/hda1 is the target):

knoppix bootfrom=/dev/hda1/knx/knoppix.iso

After the system is booted from the hard drive, the boot CD can be removed.

The path to the ISO image is one of the following:
- From the booted CD: /mnt/hda1/knx/knoppix.iso
- From the booted target partition: /knx/knoppix.iso

The following CD burning software can be used:

K > Multimedia > K3b

Using the above software, the following menu option can be used to burn a CD from the ISO image:

Tools > CD > Burn CD Image

3. Future Work

Future work will include a migration to Knoppix version 4, which can boot from a DVD, thus removing storage barriers for desired software. In addition, an effort to improve the boot performance would be beneficial.

4. References

Hacks05   *Knoppix Hacks*, Kyle Rankin, O'Reilly, 2005.

Irvine03   Irvine, C., Shifflett S., Clark, P., Levin T., Dinolt, G., *Monterey Security Enhanced Architecture Project*, DARPA DISCEX Conference, April 2003.

Knoppix   "What is Knoppix?", http://www.knoppix.org.

Appendices

A Knx Shell Script

A.1 Knx Explained

The KNX Shell Script was written to simplify the steps to re-master a Knoppix CD. The syntax of the script is:

knx {doformat | dosource | domaster | docustom | doiso | doburn }

It expects the "partition" shell variable to be assigned the target partition (e.g., "hda1"). The actions normally taken were divided up into steps that may need to be done as a group. The command options are explained below:

doformat	Prepares the target hard disk partition by formatting it, and preparing it for the Knoppix source. When it is done, it prompts the user whether to continue to the next step (dosource).
dosource	Copies the Knoppix source from the booted CD, as well as any "kick list" (kick.txt), to the target partition.
domaster	Copies the boot files from the CD to the target partition.
domysea	Performs configuration changes that are specific to the MYSEA network, and the needs of a thin client in that environment.
dokick	Re-masters the target partition by deleting all packages specified in the kick list (if provided).
doiso	Goes through the steps necessary to create a bootable ISO image from the target hard disk partition. The final "knoppix.iso" image is stored in TBD.

A.2 The Knx Script

```
#!/bin/bash

#
# fuctions
#

part=${partition}
ksource=/mnt/${part}/knx/source/KNOPPIX
kmaster=/mnt/${part}/knx/master/KNOPPIX

format_disk() {
      [ ! -b /dev/${part} ] && {  echo "No partition"; exit 1; }
```

```
       [ -d /mnt/${part}/knx ] && umount /mnt/${part}
       mke2fs /dev/${part}
       mount -rw /dev/${part} /mnt/${part}
       mkdir /mnt/${part}/knx
       mkdir -p ${ksource}
       mkdir -p ${kmaster}
       ls -lR /mnt/${part}
}


copy_source() {
       [ ! -d ${ksource} ] && { echo "No source directory"; exit 1; }
       echo "Copying knoppix source..."
       cp -Rp /KNOPPIX/* ${ksource}
       du -s ${ksource}
}


copy_master() {
       [ ! -d ${kmaster} ] && { echo "No master directory"; exit 1; }
       echo "Copying knoppix master..."
       rsync -a --exclude "/KNOPPIX/KNOPPIX" \
             /cdrom/ /mnt/${part}/knx/master/
       du -s /mnt/${part}/knx/master
}


mysea_config() {
       [ ! -d /mnt/${part}/knx ] && mount -rw /dev/${part} /mnt/${part}
       [ ! -f ${ksource}/etc/dhcpc/resolv.conf ] && \
             { echo "No source"; exit 1; }
       cd ${HOME}

       # Make sure all the files we need are here before we do anything.
       if [ ! -e hosts ]; then
             echo "No hosts file exists in the home directory.";
             exit 1;
       fi
       if [ ! -d .mozilla/firefox/3d4ef4xp.default ]; then
             echo "No Firefox configuration directory exists.";
             exit 1;
       fi
       if [ ! -d .mozilla-thunderbird ]; then
             echo "No Thunderbird configuration directory exists.";
             exit 1;
       fi
       if [ ! -e 45xsession ]; then
             echo "No 45xsession file exists in the home directory.";
             exit 1;
       fi
       if [ ! -e knoppix-autoconfig ]; then
             echo "No knopix-autoconfig file exists in the home
directory.";
             exit 1;
       fi
       if [ ! -e perftests ]; then
             echo "No performance test software exists."
             exit 1;
       fi
```

```
        # Now try to copy everything into the right place on the hard
drive.
        echo "Cleaning up.";
        rm -rf ${ksource}/etc/skel/.mozilla-thunderbird/
        rm -rf ${ksource}/etc/skel/perftests/

        echo "Copying files."
        cp hosts ${ksource}/etc/
        cp 45xsession ${ksource}/etc/X11/Xsession.d/
        cp knoppix-autoconfig ${ksource}/etc/init.d/
        cp .kde/share/config/kickerrc
${ksource}/etc/skel/.kde/share/config/
        cp .mozilla/firefox/3d4ef4xp.default/bookmarks.html \
            ${ksource}/etc/skel/.mozilla/firefox/3d4ef4xp.default/
        cp .mozilla/firefox/3d4ef4xp.default/prefs.js \
            ${ksource}/etc/skel/.mozilla/firefox/3d4ef4xp.default/
        cp -R .mozilla-thunderbird ${ksource}/etc/skel/
        cp -R perftests ${ksource}/etc/skel/

        echo "Changing permissions"
        find ${ksource}/etc/skel/.mozilla-thunderbird -type d \
            -exec chmod go+rx {} \;
        find ${ksource}/etc/skel/.mozilla-thunderbird -type f \
            -exec chmod go+r {} \;

        echo "Done."
}


remove_pkgs() {
        [ ! -e kick.txt ] && { echo "No kick.txt file exists"; exit 1; }

        echo "Copying kick file"
        rm -f ${ksource}/opt/kick.txt
        cp kick.txt ${ksource}/opt
        sync

        echo "Creating slim file"
        echo "mount -t proc /proc proc" > ${ksource}/opt/slim
        echo "apt-get --purge remove \`cat /opt/kick.txt\`" >>
${ksource}/opt/slim
        echo "apt-get clean" >> ${ksource}/opt/slim
        echo "umount /proc" >> ${ksource}/opt/slim
        chmod 700 ${ksource}/opt/slim

        echo "Removing packages"
        chroot ${ksource} /opt/slim
}

create_iso() {
        [ ! -d ${kmaster} ] && { echo "No master directory"; exit 1; }
        echo "Creating ISO cloop filesystem..."
        rm -f .bash_history
        cd /mnt/${part}/knx
        rm -rf source/KNOPPIX/.rr_moved
        mkisofs -R -U -V "KNOPPIX filesystem" -P "KNOPPIX remaster" \
            -hide-rr-moved -cache-inodes -no-bak \
```

```
                -pad source/KNOPPIX \
                | nice -5 /usr/bin/create_compressed_fs - 65536 \
                > master/KNOPPIX/KNOPPIX

        echo "Updating md5 checksum..."
        cd /mnt/${part}/knx/master
        rm -f KNOPPIX/md5sums
        find -type f -not -name md5sums -not -name boot.cat \
                -not -name iso;inux.bin -exec md5sum {} \; \
                >> KNOPPIX/md5sums

        echo "Creating final iso image..."
        cd ..
        mkisofs -pad -l -r -J -v -V "KNOPPIX" -no-emul-boot \
                -boot-load-size 4 -boot-info-table \
                -b boot/isolinux/isolinux.bin \
                -c boot/isolinux/boot.cat \
                -hide-rr-moved -o knoppix.iso master/
        ls -l knoppix.iso
}



step=(doformat dosource domaster domysea dokick doiso)
opt=$1
answer=y

if [ -z $part ]; then
    echo "The 'partition' variable has not been set."
    exit 1;
fi

while [ $answer = y ]; do
      index=""
      for i in ${step[@]}; do
            if [ $i = $opt ]; then
                  index=$i
                  continue
            fi
            if ! [ -z $index ]; then
                  opt=$i
                  break
            fi
      done
      case $index in
            doformat)   format_disk ;;
            dosource)   copy_source ;;
            domaster)   copy_master ;;
            domysea)    mysea_config ;;
            dokick)        remove_pkgs ;;
            doiso)         create_iso ;;
            *)          echo "Usage: $0 $1"
                        exit 0 ;;
      esac
      echo "Remaster step \"$index\" completed"
      echo "------------------------------------------------------------"
      last=doiso
```

```
       [ $index = $last ] && break
       echo -n "Continue to the next step ($opt)? [y/n] "
       read answer
done
exit 0
```

B The MYSEA Configuration Changes

It would be wise to create the files specified in this appendix once and put them onto removable media so they can be quickly reused, instead of recreating them every time the Knoppix CD is rebooted. Creating a re-mastered disk may take several tries before it behaves as desired.

B.1 Kick List (kick.txt)

A file named "kick.txt" must exist in the home directory with the following contents:

```
nessus
nessusd
nessus-plugins
startnessus-knoppix
ethereal
ethereal-common
mysql-server
mysql-common
gcc
gdb
g++
g++-3.3
gcj-3.3
apache
apache2-utils
apache-common
apache-utils
cvs
nmap
netcat
netcat6
```

B.2 Hosts File

A file named "hosts" must exist in the home directory with the following contents:

```
127.0.0.1      knoppix     localhost
192.168.0.130  mlsserver.cisrlabmlstestbed1.com    mlsserver
192.168.100.1  ntara.cisrlabmlstestbed2.com        ntara
192.168.101.1  stara.cisrlabmlstestbed3.com        stara
192.168.102.1  ctara.cisrlabmlstestbed4.com        ctara
```

B.3 Autoconfig (knoppix-autoconfig)

Perform the following steps to modify the existing knoppix-autoconfig file:
1. Copy "/etc/init.d/knoppix-autoconfig" to the home directory.
2. Open the file in the home directory for editing.
3. Just below the following line:
   ```
   CMDLINE="$(cat /proc/cmdline)"
   ```
   add the following line:
   ```
   CMDLINE="$CMDLINE nodhcp"
   ```
4. Below the line that starts with the following:
   ```
   echo " ${BLUE}Skipping DHCP broadcast…"
   ```
   add the following lines:
   ```
   ifconfig eth0 192.168.3.11 netmask 255.255.255.0 \
   broadcast 192.168.3.255 up
   route add default gw 192.168.3.1
   ```
5. Save the changes and exit the editor.

B.4 Browser Configuration changes

1. From the toolbar (**not** a root command-line window), start "firefox".
2. Edit > Preferences
3. Select "General" from the left-hand pane.
   Select: Use Blank Page
   Select "Connection Settings"
       Select: "Manual Proxy Configuration"
           Check: Use the same proxy for all protocols
           HTTP Proxy: mlsserver.cisrlabmlstestbed1.com
           Port: 80
           No Proxy for: localhost, 127.0.0.1, mlsserver.cisrlabmlstestbed1.com
           OK
4. Select "Privacy" from the left-hand pane.
   Select "History"
           Remember: 0 days
   Select "Cache"
           Use up to: 0 KB
   OK
5. Bookmarks > Manage Bookmarks
   File > New Folder
           Name: Demo Links
           OK
   Select "Demo Links" folder
   File > New Bookmark
           Name: "MLS Server"
           Location: http://mlsserver.cisrlabmlstestbed1.com
           OK
   File > New Bookmark
           Name: ntara
           Location: https://ntara.cisrlabmlstestbed2.com/tarantella/

                    OK
        File > New Bookmark
                    Name: stara
                    Location: https://stara.cisrlabmlstestbed3.com/tarantella/
                    OK
        File > New Bookmark
                    Name: ctara
                    Location: https://ctara.cisrlabmlstestbed4.com/tarantella/
                    OK
        File > New Bookmark
                    Name: Coalition
                    Location: http://mlsserver.cisrlabmlstestbed1.com/coalition/
                    OK
        Make sure all added bookmarks are in the Demo Links folder in the following
        order:
                    MLS Server
                    ntara
                    stara
                    ctara
                    Coalition
        File > Close
   6. Exit the browser

B.5 Email Settings

   1. Select **K > Internet > Thunderbird Mail Client**.
   2. Don't import anything.
   3. New Account Setup:
        Email account
   4. Identity:
        Your Name: Demo 2
        Email Address: mdemo2@mlsserver.cisrlabmlstestbed1.com
   5. Server Information
        IMAP
        Incoming Server: mlsserver.cisrlabmlstestbed1.com
        Outgoing Server: mlsserver.cisrlabmlstestbed1.com
   6. User Names
        Incoming User Name: mdemo2
   7. Account Name
        Demo 2
   8. Edit > Account Settings
        Server Settings (left pane)
                    Uncheck: Check for new messages at startup
                    Uncheck: Check for new messages every XX minutes
                    When I delete a message: Remove it immediately
                    Check: Clean up ("Expunge") Inbox on Exit
                    Check: Empty Trash on Exit

Copies & Folders (left pane)
> **Uncheck**: Place a copy in:

Outgoing Server (SMTP) (left pane)
> **Uncheck**: use name and password

OK

9. Address Book
   New Card
   > Display: Demo 1
   > Email: mdemo1@mlsserver.cisrlabmlstestbed1.com
   > OK

10. File > Quit

B.6 Application Startup

1. Copy the "/etc/X11/Xsession.d/45xsession" file to the home directory.
2. Open the file in the home directory for editing.
3. Replace the following line:

   ```
   Exec=konqueror  --geometry 850x600+85+70 file:$INDEXFILE
   ```
   With this line:
   ```
   Exec=firefox --geometry 850x600+85+70
   ```

4. Below the if/fi block that starts with the following:

   ```
   if [ ! -e $HOME/.mozilla -a "$FREESPACE" -gt 1500 ]
   ```
   Add the following if/fi blocks:
   ```
   if [ ! -e $HOME/.mozilla-thunderbird -a "$FREESPACE" -gt 1800
   ] && [ -d /etc/skel/.mozilla-thunderbird ]; then
   rsync -Ha --ignore-existing /etc/skel/.mozilla-thunderbird
   $HOME/ 2>/dev/null
   find $HOME/.mozilla-thunderbird -type f -exec chmod go-r {}
   \;
   find $HOME/.mozilla-thunderbird -depth -type d -exec chmod
   go-rx {} \;
   else
   echo "Unable to configure Thunderbird."
   fi
   if [ ! -e $HOME/perftests -a "$FREESPACE" -gt 25000 ] && [ -d
   /etc/skel/perftests ]; then
   rsync -Ha --ignore-existing /etc/skel/perftests $HOME/
   2>/dev/null
   else
   echo "Unable to install performance tests."
   fi
   ```

5. Save the file.

B.7 Toolbar Configuration

1. Right-click unused part of the toolbar panel.
2. Remove From Panel > Application Button > Home
   Remove From Panel > Application Button > Knoppix
   Remove From Panel > Application Button > Knoqueror
   Remove From Panel > Application Button > Open Office

3. Remove From Panel > Special Button > Desktop Access
   Remove From Panel > Special Button > Window List
4. Add to Panel > Application > Internet > Thunderbird Mail Client
5. If necessary, move the toolbar icons so that the Firefox and Thunderbird icons are next to each other.

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